**Genetics Problems: Monohybrid Crosses**

**Multiple Choice**

**Question 1**

A normal (but hybrid) person for skin colour marries a pure dominant (normal) person for skin colour. How many children out of four could be albino?

1. None
2. One
3. Two
4. Three

**Short Answer**

**Question 1**

Vinegar flies, *Drosophila melanogaster*, with red eyes (R) x fruit flies with vermilion eyes (r), in which red-eye is dominant to vermilion. Determine the correct genotypic and phenotypic ratios for the F1 generation if:

1. The red-eyed flies are homozygous
2. The red-eyed flies are heterozygous

**Question 2**

A heterozygous brown-eyed woman mates with a blue-eyed man, in which brown eyes are dominant to blue. Determine the correct genotypic and phenotypic ratios for the F1 generation.

**Question 3**

Long-winged flies were mated and produced an F1 consisting of 777 long-winged and 24 short-winged flies.

1. Which is recessive, short-winged or long-winged? Explain your answer
2. What were the parental genotypes?

**Question 4**

In rabbits, black fur is dominant to white. Two black rabbits had a total of 38 offspring of which 9 were white and the remainder black. What are the genotypes of the parent rabbits?

**Question 5**

Albinism (failure to produce pigment) is an autosomal recessive condition in humans. Two normally pigmented parents have an albino child.

1. What is the chance that their next child will be an albino?
2. What is the chance that the next two children are albinos?\*
3. The parents have two more children. What is the chance that one of these will be an albino and the other have normal pigmentation?\*

**Question 6**

In sheep, white wool is dominant to black. Two white sheep, each carriers of black, have a white male lamb. This lamb is back-crossed to its mother. What is the probability that the backcross offspring will be black?\*

**Question 7**

Hurler syndrome is inherited as an autosomal recessive condition. A couple, each normal, have a Hurler syndrome child.

1. Assign allele symbols for this condition.
2. What is the genotype of each parent?
3. In genetics, what is the meaning of the term ‘carrier’?
4. What is the chance that their next child will also have Hurler syndrome?
5. What is the chance that the next child will be homozygous normal?
6. The couple have a normal child. What is the chance that this child is a carrier of the trait?
7. Another couple, both carriers of Hurler syndrome, have four children. What is the chance that all four children have Hurler syndrome?\*

**Question 8**

In guinea pigs, a coat colour gene has the alleles CY: yellow and CW: white. Heterozygotes are cream in colour. In a mating between two cream guinea pigs, what genotypes and phenotypes would be expected in the offspring and what is the expected proportion of each?

**Question 9**

The eye colour of a fruit fly is determined by a single gene that has dominant and recessive alleles. The allele for red eye (R) is dominant over the allele for white eye (r).

1. Identify possible genotypes of a fruit fly with red eyes
2. Two flies heterozygous for eye colour are crossed. Use a Punnett square to predict the results of this cross.
3. Calculate the percentage of offspring that are expected to have red eyes.
4. Calculate the percentage of offspring that are expected to be heterozygous.
5. Flies with red eyes may be homozygous or heterozygous. To determine which genotype a red-eyed fly is, a test-cross may be carried out. This involves crossing the red-eyed fly with a homozygous white-eyed fly. Create Punnett square to show the results of a test cross with both homozygous and heterozygous red-eyed flies.
6. If the unknown fly is homozygous (RR), predict the colour of the offspring’s eyes and in what proportions.
7. If the unknown fly is heterozygous (Rr), predict the colour of the offspring’s eyes and in what proportions.
8. Explain why a test-cross is unnecessary to decide the genotype of a white-eyed fly.

**Question 10**

A newly married couple, Petra and George are concerned one of their future children could have a rare genetic disease as George suffers this disease. After testing, it was found Petra was homozygous dominant WITHOUT the disease and George was homozygous recessive WITH the disease.

1. Create a Punnett square to show their possible offspring.
2. What percentage of children could develop the disease?

**Question 11**

Jenna and Julio would like to have children in the next few years and both know they are CARRIERS of the gene for Muscular Dystrophy.

1. Create a Punnett square to show their possible offspring, using the alleles M and m.
2. Calculate the proportion of children who are normal (homozygous dominant).
3. Calculate the proportion of children who are carriers (hybrid).
4. Calculate the proportion of children who are diseased (homozygous recessive).

**Question 12**

Mesina has just returned from the doctors after being told she has the dominant disease Huntington’s Chorea (her genotype is Hh where H is the allele for the disease). She fancies Peter who is homozygous normal (hh) but she is scared one of their future children could develop the disease. Using a Punnett square, determine the proportion of their children who could have the disease.

**Question 13**

Determine the percentage or fraction of offspring that would show a disease with the genotype cc if:

1. The mother and father both have a genotype of Cc
2. The mother has the genotype CC and the father cc
3. The mother has the genotype CC and the father Cc
4. The mother has the genotype cc and the father Cc

**Answers**

**Short Answer**

**Question 1**

# a. Parents: RR x rr

Gametes: R and r

Genotypic Ratio: 100% Rr

## Phenotypic Ratio: 100% red-eyed

# b. Parents: Rr x rr

# Gametes R, r and r

Genotypic Ratio: ½ Rr : ½ rr

Phenotypic Ratio: ½ red-eyed : ½ vermilion-eyed

**Question 2**

# Parents: Bb x bb

Gametes: B, b and b

Genotypic ratio: ½ Bb : ½ bb

Phenotypic ratio: ½ Brown : ½ Blue

**Question 3**

a. Ratio is 777 long : 24 short, which is approximately a 3:1 ratio expected in a monohybrid cross. Dominant trait expected to be 3, and recessive expected to be 1 – therefore long is dominant.

b. 3:1 ratio consistent with monohybrid cross of two heterozygotes, therefore parents are Ll x Ll

**Question 4**

Approximate 3:1 ratio is typical of a cross between two heterozygotes. If the allele for black is B and the allele for white is b, then the genotype of each parent is Bb.

**Question 5**

a. 1/4

b. 1/4 x 1/4 = 1/16

c. Combinations of offspring include: albino then non-albino AND non-albino then albino

Chance of albino = 1/4 ; chance of non-albino = 3/4

Answer = (1/4 x 3/4) + (3/4 x 1/4) = 6/16 = 3/18

**Question 6**

Let W = white and w = black

Parents: Ww x Ww

|  |  |  |
| --- | --- | --- |
|  | W | w |
| W | WW | Ww |
| w | Ww | ww |

White offspring could be WW or Ww, however the Q states that the offspring produces a black lamb, so he must be Ww.

The chance of a white male lamb being Ww is 2/3 (already know he’s white)

Backcross to mother: Ww x Ww

|  |  |  |
| --- | --- | --- |
|  | W | w |
| W | WW | Ww |
| w | Ww | ww |

Chance of offspring being black: ¼

Therefore, 2/3 x 1/4 = 2/12 = 1/6

**Question 7**

a. H = normal, h = Hurler syndrome

b. Hh and Hh

c. Carrier =

d. Hh x Hh 1/4

|  |  |  |
| --- | --- | --- |
|  | H | h |
| H | HH | Hh |
| h | Hh | hh |

e. 1/4

f. 2/3

g. 1/4 x 1/4 x 1/4 x 1/4 = 1/256

**Question 8**

|  |  |  |
| --- | --- | --- |
|  | CY | CW |
| CY | CY CY | CW CY |
| CW | CY CW | CW CW |

Genotypes: 1/4 CY CY , 1/2 CY CW, 1/4 CW CW Phenotypes: 1/4 yellow, 1/2 cream, 1/4 white

**Question 9**

a. RR or Rr

b. Rr x Rr

|  |  |  |
| --- | --- | --- |
|  | R | r |
| R | RR | Rr |
| r | Rr | rr |

c. 75%

d. 50%

e. Test cross one: RR x rr Test cross two: Rr x rr

|  |  |  |
| --- | --- | --- |
|  | R | r |
| r | Rr | rr |
| r | Rr | rr |

|  |  |  |
| --- | --- | --- |
|  | R | R |
| r | Rr | Rr |
| r | Rr | Rr |

f. All offspring red-eyed

g. 50% red-eyed, 50% white-eyed

h. As the white-eyed trait is recessive, all white-eyed offspring must be rr

**Question 10**

**a.** b. 0%

|  |  |  |
| --- | --- | --- |
|  | D | D |
| d | Dd | Dd |
| d | Dd | Dd |

**Question 11**

|  |  |  |
| --- | --- | --- |
|  | M | m |
| M | MM | Mm |
| m | Mm | mm |

a. b. 1/4 c. 1/2 d. 1/4

**Question 12**

|  |  |  |
| --- | --- | --- |
|  | H | h |
| h | Hh | hh |
| h | Hh | hh |

50%

**Question 13**

1. 25% or ¼
2. 0
3. 0
4. 50% or ½